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10/628,194	07/28/2003	Vetrivel Ayyavu	03-0392	6124

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EXAMINER	
PEYTON, TAMMARA R	

ART UNIT	PAPER NUMBER
2182	

MAIL DATE	DELIVERY MODE
01/09/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/628,194	AYYAVU ET AL.	
	Examiner	Art Unit	
	Tammara R. Peyton	2182	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 October 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,6-11 and 22-25* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,6-11 and 22-25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

The indicated allowability of claims 1, 6-11 and 22-25 is withdrawn in view of the newly discovered reference(s) to Maxtor (Serial Attached SCSI Architecture: Part 4 - the Transport Layer. October 2003 - 6 page). Rejections based on the newly cited reference(s) follow.

Regarding claim 1, the recitation "a standard advanced technology attachment queuing automation circuit," has not been **given patentable** weight because the recitation occurs in the preamble. A preamble is generally not accorded any patentable weight where it merely recites the purpose of a process or the intended use of a structure, and where the body of the claim does not depend on the preamble for completeness but, instead, the process steps or structural limitations are able to stand alone. See In re Hirao, 535 F.2d 67, 190 USPQ 15 (CCPA 1976) and Kropa v. Robie, 187 F.2d 150, 152, 88 USPQ 478, 481 (CCPA 1951).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 6-11 and 22-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maxtor ("Serial Attached SCSI Architecture: Part 4 - the Transport Layer, October 2003 - 6 page") and Nemazie (US2004/0252716).

As per claims 1 and 11, Maxtor teaches a first circuit for storing a command from a higher layer of a serial advanced technology attachment (SATA) device (SAS multiple target device, Fig. 1);

a second circuit (initiator port, Figs. 2-5) for creating a frame information structure (FIS) corresponding to the command, communicating with a transport layer of the SATA device (See definition of SAS, SSP frame structure transmission sequences, pgs. 2, 3, 5), and transmitting the frame information structure to the transport layer (pg. 2, Fig. 2) of the SATA device; and

a third circuit (target port, Figs. 2-5) for receiving a FIS from the transport layer of the SATA device, decoding the received FIS, and taking an appropriate action. (pgs. 2-5)

Maxtor teaches using a SAS device and a plurality of SAS transport layer processing elements each communicatively coupled to a SAS application layer processing element via initiator ports wherein each SAS transport layer processing element is adapted to exchange frame information structure information received from the SAS application layer processing element with one or more of the other SAS devices (page 2 paragraph 2 - figure 2)

As per claims 6-11and 22-25 Maxtor does not teach a command completion queue. However, Nemazie teaches a command completion (FIFO) queue [0133,0147] that receives commands and wherein the command completion queue is implemented in software or hardware. (Fig. 8a-9) [0016, 0026, 0097-0100, 0134-0155, 0191]

It would have been obvious to one having ordinary skill in the art at the time the invention was made to incorporate the teachings of both the Maxtor and Nemazie references into a single embodiment because both systems teach an overview of the Serial Attached SCSI Architecture and furthermore Nemazie completion queue would properly handle the requests and frame transmissions of the application/transport layer of Maxtor.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tammara Peyton whose telephone number is (571) 272-4157. The examiner can normally be reached between 6:30 - 4:00 from Monday to Thursday, (I am off every first Friday), and 6:30-3:00 every second Friday. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alford Kindred can be reached on (571) 272-4037. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300. Any inquiry of a

general nature of relating to the status of this application should be directed to the Group receptionist whose telephone number is (571) 272-2100.

TAMMARA PEYTON
PRIMARY EXAMINER

Tammara Peyton

Tammara Peyton

January 6, 2008

Notice of References Cited	Application/Control No. 10/628,194	Applicant(s)/Patent Under Reexamination AYYAVU ET AL.	
	Examiner Tammara R. Peyton	Art Unit 2182	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-7,171,500	01-2007	Day et al.	710/106
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	□□Maxtor - Serial Attached SCSI Architecture: Part 4 - the Transport Layer. October 2003 - 6 page
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Serial Attached SCSI Architecture: Part 4 – the Transport Layer

Mark Evans

Introduction

Serial Attached SCSI (SAS) is a new storage interface standard developed by the ANSI INCITS T10 technical committee. This is the fourth in a series of white papers describing the layers in the SAS architecture as defined in the SAS standard. Figure 1 shows the SAS architecture layers and the relationships between them.

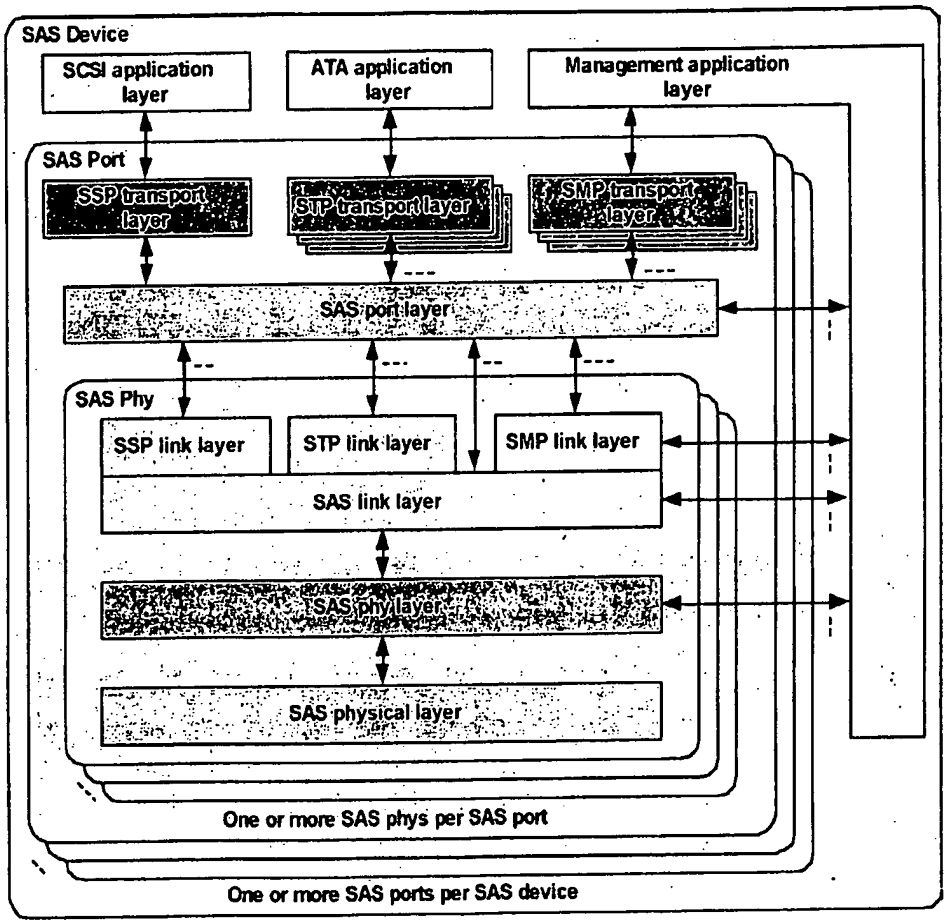

Figure 1 – SAS architecture

As seen in figure 1, the SAS architecture is divided into six layers. From lowest to highest, these are: the physical layer, the phy layer, the link layer, the port layer, the transport layer, and the application layer. The bottom five layers (all but the application layer) are contained in the SAS port (with the exception of the cable assemblies and connectors described in the SAS physical layer). This means that applications (like software programs and device drivers) used to communicate with parallel SCSI ports or parallel ATA devices may also be used to communicate with SAS ports with little or no modification. This white paper will focus on explaining the content of the SAS transport layer.

The SAS transport layer

The transport layer is the second-highest layer of the SAS architecture defined in the SAS standard and the highest layer in the SAS port. There is one transport layer in each SAS port to interface with each type of application layer supported by the port. There is an SSP transport layer in a port if a SCSI application layer is supported, an STP transport layer in a port if an ATA application layer is supported, and an SMP transport layer in a port if a management application layer is supported. All SAS transport layers in a port interface with one SAS port layer. Figure 2 shows SAS initiator ports and SAS target ports connected to each other through a SAS service delivery subsystem.

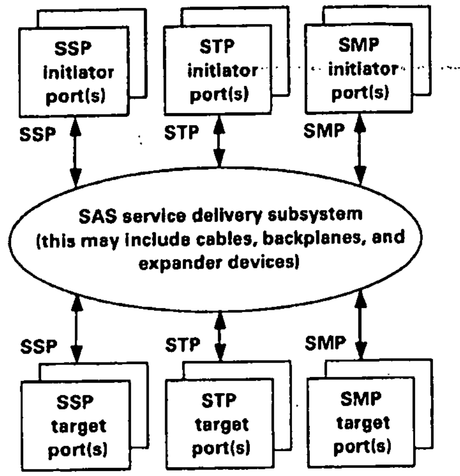

Figure 2 – SAS domain

A transport layer receives requests from its associated application layer (for example, the SSP initiator transport layer in a SAS port receives requests from the SCSI application layer in the SAS device to transmit a SCSI command to a SAS target port), constructs frames, sends frames to the port layer, receives confirmations of transmission and receipt of frames from the port layer, validates frames, and sends confirmations to the application layer. Validation of frames by the transport layer includes checking to insure that frames are of the correct type, are the correct length, and were transmitted to the correct device.

SAS frames

All information, except primitives, is transmitted between two SAS devices using frames. There are two types of frames: those transmitted during a connection, and address frames. (For a description of address frames see the second white paper in this series about the SAS link layer.) Frames transmitted during a connection are constructed by a SAS transport layer. SSP frames and SMP frames are described in the SAS standard. The Frame Information Structures for STP frames are described in the ATA standard.

SSP frames

SSP frames are constructed by the SSP transport layer in a SAS port as the result of requests received from the SCSI application layer in the SAS device. There are five types of SSP frames. An SSP frame type is associated with the type of information unit contained in the frame. The information unit types are COMMAND, DATA, XFER_RDY (for "transfer ready"), RESPONSE, and TASK.

COMMAND frames are transmitted from SSP initiator ports to SSP target ports. A COMMAND information unit contains a SCSI command descriptor block (CDB), the logical unit number (LUN) of the logical unit in the SAS target device to which the command is being transmitted, and information about how the command is to be processed (for example, this task is to be processed as an ordered task in the queue).

DATA frames containing write (data-out) data are transmitted from SSP initiator ports to SSP target ports. DATA frames containing read (data-in) data are transmitted from SSP target ports to SSP initiator ports. Data in DATA frames must be in multiples of four bytes, except for the data in the last DATA frame for a command. The maximum amount of data that may be included in a DATA frame is 1,024 bytes.

XFER_RDY frames are transmitted from an SSP target port to an SSP initiator port to inform the initiator port that it may transmit data to the target port for a data-out command. An XFER_RDY information unit contains the amount of write data that the initiator port may transfer for a data-out command without receiving another XFER_RDY frame for that command and a requested data offset value. The amount of data that an initiator may transfer as indicated by the value in the XFER_RDY frame

may be less than the total amount of data specified by the command. The data offset value begins at zero for the first data transferred for a command and increments. The data offset value in a subsequent XFER_RDY for a command would be the value from the previous XFER_RDY for the command plus the amount of data that was transferred. An SSP target port may send XFER_RDY frames for more than one command, but there can only be one outstanding XFER_RDY per command.

RESPONSE frames are transmitted from an SSP target port to an SSP initiator port to provide information and status, usually after a command or task is completed. RESPONSE information units may contain SCSI status and sense information or other response data.

TASK frames are transmitted from SSP initiator ports to SSP target ports to manage tasks previously received by the target port and other target resources. Task management functions specified by TASK frames include: ABORT TASK, ABORT TASK SET, CLEAR TASK SET, LOGICAL UNIT RESET, and QUERY TASK.

In addition to frame type specific information, all SSP frames contain the following information:

a. The hashed source and destination SAS address values are 24-bit values calculated from the 64-bit SAS addresses of the two SAS ports in the connection. The shorter format of the hashed addresses allows for the receiving port to quickly double-check that the frame has been properly routed to the receiving port.
b. The tag value is a 16-bit value. The tag in a COMMAND frame is used by a target port to establish context for the task specified by the command. The tag value in subsequent DATA and RESPONSE frames associates them with a previously received command having the same tag. A TASK frame not only has a tag for the management function associated with the frame, but may also contain the tag for a previously received command to be managed by the function specified by the frame. For example, a TASK frame with the management function ABORT TASK would contain its own tag and the tag of the command to abort.
c. The target port transfer tag value may be used by a target port to associate a received DATA frame for a data-out operation to a command without having to perform a full tag lookup. This is most useful when a target port has transmitted an XFER_RDY indicating that it may receive DATA frames for more than one command.
d. The data offset value is used in DATA frames only and provides a method to ensure that data is delivered in order.
e. The CRC value provides a 32-bit CRC error checking mechanism on the content of the frame.

The contents of frames are constructed in the SSP transport layer, except for the CRC, which is calculated in the link layer. (For more information about CRC and data scrambling, see the second white paper in this series about the SAS link layer.)

SSP frame transmission sequences

The following describes examples of the sequences of frame transmissions for single SSP task management functions and commands. All of the frames required to complete an SSP command or task management function need not be transmitted during one connection. For example, a COMMAND frame for a data-in command could be transmitted in a connection originated by an SSP initiator port, and the DATA frames and RESPONSE frame for the command could be transmitted in one or more subsequent connections originated by the SSP target port. Also, transmission of frames for different commands and task management functions may be interleaved when several commands and/or task management functions are outstanding.

There are only a few restrictions in SAS on the order of frame delivery. For example, SAS initiator ports cannot transmit any DATA frames for a command until the COMMAND frame associated with the data has been transmitted and receipt of the frame acknowledged (for additional information about frame delivery rules, see the third white paper in this series about the SAS port layer).

In the following sequences, all of the communications between the SCSI application layer and the SSP transport layer (for example, Send Task Management Request) are defined in the SCSI Architecture Model standard. These conceptual requests and responses are implemented by all SCSI transports, including parallel SCSI, iSCSI, and Fibre Channel.

Figure 3 shows an example of a sequence for a task management function as observed from the SSP transport layer.

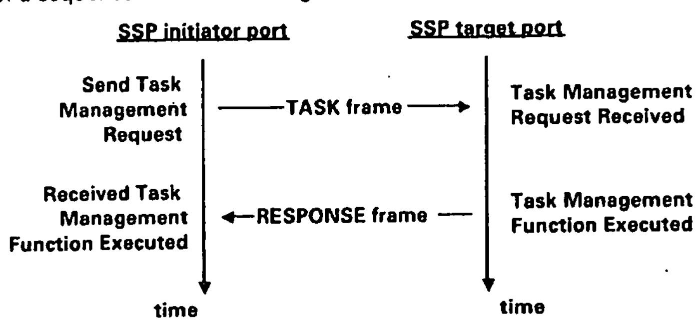

Figure 3 – SSP task management function sequence

In the sequence illustrated above, the initiator's SCSI application layer initiates the sequence by sending a request to the SSP initiator transport layer to transmit a task management function to an SSP target port. The initiator transport layer constructs a TASK frame and transmits it to the SSP target port by sending a request to the initiator's SAS port layer. The SSP target transport layer receives, parses, and validates the TASK frame and sends an indication to the target's SCSI application layer that a task management request has been received (a target's SCSI application layer for a hard disk drive would usually be implemented in the drive's firmware). The target's SCSI application layer performs the task management function and sends a response to the target transport layer for the request. The target transport layer constructs a RESPONSE frame and transmits it to the SSP initiator port by sending a request to the target's SAS port layer. The SSP initiator transport layer receives, parses, and validates the RESPONSE frame and sends a confirmation to the initiator's SCSI application layer that the task management function has been executed.

Figure 4 shows an example of a sequence for a data-in (or read) command as observed from the SSP transport layer.

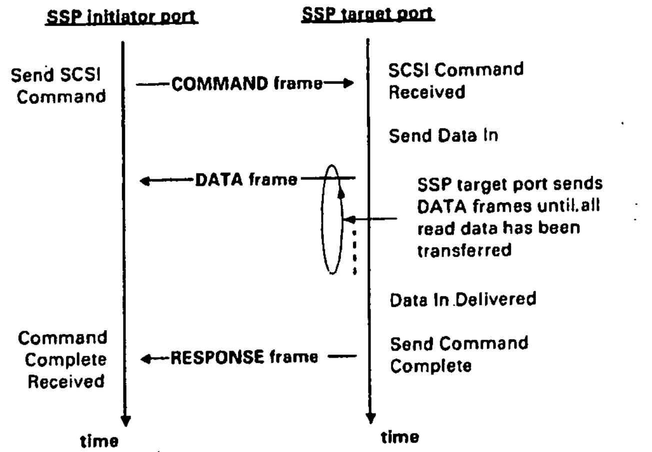

Figure 4 – SSP data-in command sequence

In the sequence illustrated above, the initiator's SCSI application layer initiates the sequence by sending a request to the SSP initiator transport layer to transmit a command to an SSP target port. The initiator transport layer constructs a COMMAND frame and transmits it to the SSP target port. The SSP target transport layer receives, parses, and validates the frame and sends an indication to the target's SCSI application layer that a command has been received. The target transport layer receives a request from the target's SCSI application layer to transmit data for the command. The target transport layer constructs a DATA frame and transmits it to the SSP initiator port. The target transport layer continues to construct and transmit DATA frames until all frames have been transmitted for the request. The target transport layer informs the target's SCSI application layer when all of the data has been transferred. The target's SCSI application layer requests that the target transport layer transmit status for the command. The target transport layer constructs a RESPONSE frame and transmits it to the SSP initiator port. The SSP initiator transport layer receives, parses, and validates the RESPONSE frame and sends a confirmation to the initiator's SCSI application layer that the command is complete.

Figure 5 shows an example of a sequence for a data-out (or write) command as observed from the SSP transport layer.

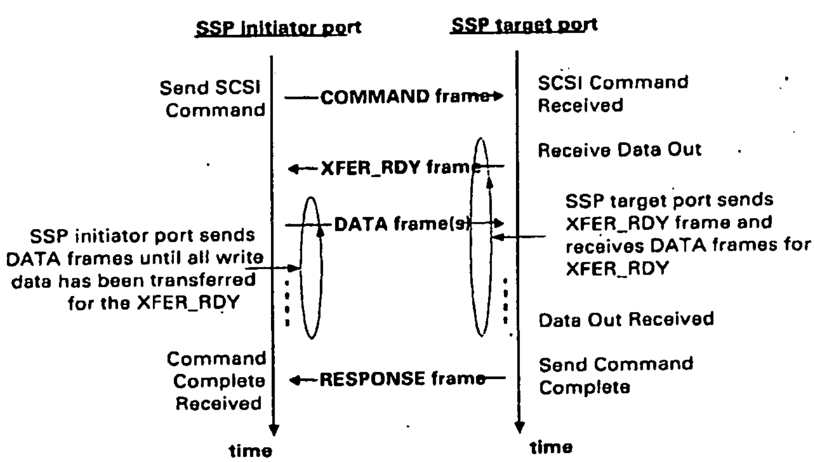

Figure 5 – SSP data-out command sequence

In the sequence illustrated above, the initiator's SCSI application layer initiates the sequence by sending a request to the SSP initiator transport layer to transmit a command to an SSP target port. The initiator transport layer constructs a COMMAND frame and transmits it to the SSP target port. The SSP target transport layer receives, parses, and validates the COMMAND frame and sends an indication to the target's SCSI application layer that a command has been received. The target's SCSI application layer sends a request to the target transport layer to receive data for the command. The target transport layer constructs an XFER_RDY frame and transmits it to the SSP initiator port. The SSP initiator transport layer receives the XFER_RDY frame and constructs and transmits DATA frames to the SSP target port until all frames have been transmitted for the XFER_RDY frame. When all DATA frames have been received for the XFER_RDY, the SSP target transport layer sends a confirmation to the target's SCSI application layer that all data has been received.

If there is still data to be transferred for the command, the target's SCSI application layer sends a new request to the SSP target transport layer to receive more data, the target transport layer transmits a new XFER_RDY, the SSP initiator port transmits more write data, and the SSP target transport layer sends a confirmation to the target's SCSI application layer when all data has been transferred for the request. This process continues until all of the data has been transferred for the command.

When all data has been transferred for the command, the target's SCSI application layer requests that the target transport layer transmit status for the command. The target transport layer constructs a RESPONSE frame and transmits it to the SSP initiator port. The SSP initiator transport layer receives, parses, and validates the RESPONSE frame and sends a confirmation to the initiator's SCSI application layer that the command is complete.

SMP frames

SMP frames are constructed as the result of requests from a SAS management application layer. There are two types of SSP frames: SMP_REQUEST and SMP_RESPONSE frames. SMP_REQUEST frames are used by SAS initiator ports to specify that an SMP function be performed by an SMP target port (typically contained in a SAS expander). SMP_RESPONSE frames are transmitted in response to SMP_REQUEST frames and may contain status of the requested action or other requested information.

The type of request is specified by the value in the Function field in the SMP_REQUEST frame. Depending on the function, there may be additional information in the frame (for example, specifying the phy for which information is to be returned). The function field in an SMP_RESPONSE frame transmitted in response to an SMP_REQUEST frame is set to the same value as the Function field in the SMP_REQUEST frame.

Information that may be obtained from SAS expanders includes information about the expander (for example, how many ports the expander contains), and information for the SAS devices connected to the expander and characteristics of the connected devices; for example, the device type (SSP, STP, or SMP), the device's SAS address (that is, the WWN), and the maximum link rate supported by the attached device.

SMP frame sequence

The SMP frame sequence is simple and specific. The complete operation occurs in one connection. An SMP initiator port opens a connection and transmits an SMP_REQUEST frame. The SMP target port transmits an SMP_RESPONSE frame and the connection is closed. Figure 6 shows an example of an SMP sequence as observed from the SMP transport layer.

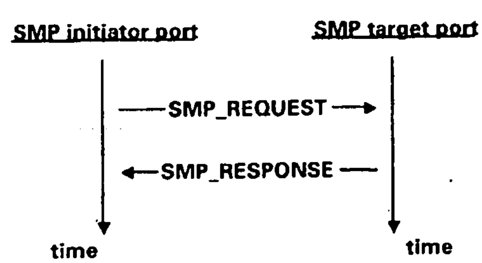

Figure 6 – SMP sequence example

In the sequence illustrated above, the initiator's management application layer sends a request to the SMP initiator transport layer to transmit an SMP_REQUEST frame. The SMP initiator transport layer constructs the frame and transmits it to the SMP target port. The SMP target transport layer receives, parses, and validates the SMP_REQUEST frame and sends the request to the target's SMP application layer. The SMP application layer sends a request to the SMP target transport layer to transmit an SMP_RESPONSE frame. The SMP target transport layer constructs the frame and transmits it to the SMP initiator port. The SMP initiator transport layer receives, parses, and validates the frame and sends a confirmation to the SMP management application layer that the request is complete.

Additional resources

More information about Serial Attached SCSI may be found on the SCSI Trade Association web site at http://www.scsita.org. SCSI and ATA standards and information about the ANSI standardization process are available at http://www.incits.org. Other information about the ANSI INCITS T10 Technical Committee for SCSI Storage Interfaces is available at http://www.t10.org. Specifications for connectors and other SFF documents are available at http://www.sffcommittee.org.

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